

# Implementation, Design, and Cost Analysis of a Concrete Washout System

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## SIGNATURE PAGE

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## **ABSTRACT**

With the increase of environmental pollution in today's world, many strategies and regulations are being enforced. These enforcements come from the state and federal governments, but public awareness is often overlooked. Stormwater regulations here in California have dramatically changed over the last decade, as the topic is investigated more often.

This senior project encompassed the design prototype and cost analysis of a permanent concrete washout station for the BioResource and Agricultural Engineering Department at California Polytechnic State University, San Luis Obispo. The design parameters given were to construct a steel bin for the excess concrete to be dumped into during and preceding certain concrete classes. The new concrete washout had to have forklift inserts, as well as easy dumping access. The size of the washout station design was dependent on usage and amount of concrete handled by the students during lab hours.

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## INTRODUCTION

**Background.** Concrete washouts are used to contain concrete and liquids associated with concrete mixing and pouring. The concrete pumps, hoppers, mixers, chutes, and any other equipment are rinsed out in the concrete washout to ensure the liquid does not enter the storm drain. The washout containers consolidate solids for easier disposal and prevent runoff of liquids. Not only is the wash water toxic, but it contains chemicals that effect everything from aquatic life to vegetation and soil.

**Justification.** The BioResource & Agricultural Engineering (BRAE) Department at California Polytechnic State University, San Luis Obispo (Cal Poly) has multiple classes who have a concrete lab throughout their respective classes. One class for example, Dr. Stuart Styles' BRAE 433 class (Agricultural Structures Design), does concrete cylinder testing as well as multiple group projects that pour concrete structures. The old concrete washout containment consisted of a wooden frame (2"x 6") with a plastic liner stapled over it. The project was brought up by Dr. Shaun Kelly and he mentioned the department was interested in the design and build of a permanent containment system.

The goal for the project was to create a concrete washout bin which satisfied every instructor's needs and wants. As far as the washout bin goes, the design was based off older past models, a low cost budget, and how well materials/fabrication meshed with the design size/specifications.

## **LITERATURE REVIEW**

### **Overview**

Concrete washouts are used to contain concrete and liquids associated with concrete mixing and pouring. The concrete pumps, hoppers, mixers, chutes, and any other equipment are rinsed out in the concrete washout to ensure the liquid does not enter the storm drain. The washout containers consolidate solids for easier disposal and prevent runoff of liquids. Not only is the wash water toxic, but it contains chemicals that effect everything from aquatic life to vegetation and soil. Construction activity nowadays has very strict regulations regarding concrete wastewater and the contaminants it contains. Every job site has to contend with regulations involving construction site runoff. Storm Water Pollution Prevention Plans (SWPPP's) are being developed to address what to do with the cleanout material from concrete mixer trucks and/or tools used on site. This excess concrete wastewater and material must be collected, contained, and disposed of properly.

### **Concrete Pollution**

**Harmful Ingredients.** Concrete or cementitious (mortar, grout, plaster, stucco, cement, slurry) washout wastewater is caustic and considered to be corrosive with a pH over 12. In perspective, a pH of over 12 is essentially the same as ammonia, Liquid Plumber, or other household cleaning detergents. Portland Cement is the primary ingredient in ready mixed concrete, which consists of Portland Cement clinker, calcium sulfate, calcium and magnesium oxide, potassium and sodium sulfate compounds, chromium compounds, and nickel compounds. Some of the contaminants contained within concrete wash water include: Aluminum, barium, chromium, hexavalent chromium, copper, iron, magnesium, manganese, nickel, potassium, selenium, sodium, vanadium, and zinc. Contact with wet (unhardened) concrete, mortar, cement, or other cementitious materials can cause skin irritation and severe chemical burns or serious eye damage. (Concrete Washout Systems Inc., 2006)

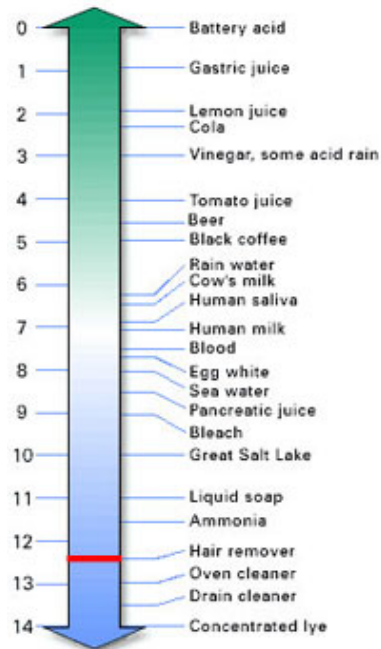


Figure 1: pH Chart (Concrete Washout Systems Inc., 2006)

**Effects of High pH on Aquatic Life.** A substance's pH is a measure of how acidic or alkaline a substance is. The pH scale goes from 0 to 14, where 7 is neutral. A high pH value means the sample is basic or alkaline, while a low pH value means the sample is acidic. A change in one pH unit means a tenfold change in concentration, it is magnified greatly just like the Richter scale and measuring earthquake magnitudes. Water that comes in contact with unset concrete quickly increases alkalinity and will be highly toxic to aquatic life. The effect of high pH, as in concrete wastewater, on fish may include: death, damage to outer surfaces (eyes, skin, gills), and the inability to dispose of metabolic wastes. Lime is a major component of cement and is found in all concrete products. Lime dissolves in water to produce an alkaline solution that will burn and kill fish, insects, and plants. Concrete wastewater has a pH of 12-13 and is as toxic as bleach or oven cleaner. A single bucket of concrete wastewater will easily kill hundreds of fish. The safe range for aquatic life is between 6.5-9.0 pH units. (Concrete Washout Systems Inc., 2006)



Figure 2: Dead fish due to concrete pollution (Concrete Washout Systems Inc., 2012)

**Effects of High pH on Vegetation and Soil.** High pH on vegetation has many effects such as: inhibited growth, damage to soil and plants and substantial alteration of the soil and plant chemical composition even after the pollution source is gone. High pH can also increase the toxicity of other substances, causing even further problems. (Concrete Washout Systems Inc., 2006)

**Turbidity.** Also called suspended solids when in water, concrete wash water is basically a slurry of fine Portland Cement particles in water. When illegally discharged into a fish-bearing waterway, it will clog fish gills. This ultimately reduces the amount of oxygen they receive which can cause death. Turbidity is the cloudiness or haziness of a fluid caused by individual particles. In clear water, the turbidity is 0 NTU (National Turbidity Units) and fish are able to catch prey. As the turbidity increases to 60 NTU, only certain fish are able to capture 5% of their prey. The average turbidity of concrete washout water coming directly from the source is 27,000 NTU. The average stream or river in the United States has a total suspended solids count of no more than 75 ppm (parts per million). The average total suspended solids in concrete washout water coming directly from the source is 79,000 ppm. (Concrete Washout Systems Inc., 2006)

### **Construction Site Activity**

**CASQA.** The California Stormwater Quality Association (CASQA) decides on regulations regarding concrete waste management for construction sites. CASQA's main objective is to prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area. The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH. Many types of construction materials, including mortar, concrete, stucco, cement and their associated wastes have basic chemical properties that can raise pH levels outside the accepted range. (CASQA, 2009)

**Above Grade Facility.** CASQA has a handbook which states all the regulations regarding construction jobs here in California. Sites large enough are required to have either an above grade or a below grade concrete washout facility. The temporary washout facility should be constructed as shown on the details in Figures 3, 4, and 5. A recommended minimum length and width of 10 feet, however, smaller sites or jobs may only need smaller washout facilities. Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects. More information can be read in Appendix D, which has the regulation from the handbook. (CASQA, 2009)

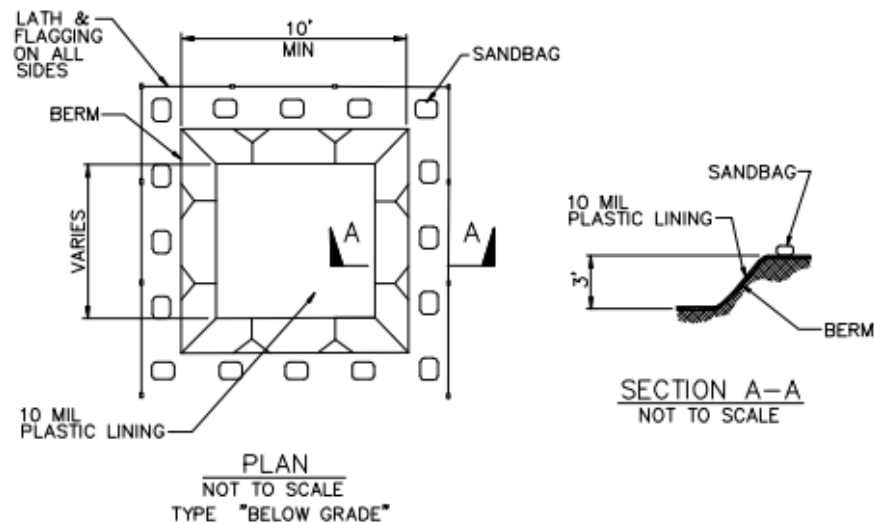


Figure 3: Below grade washout (CASQA, 2009)

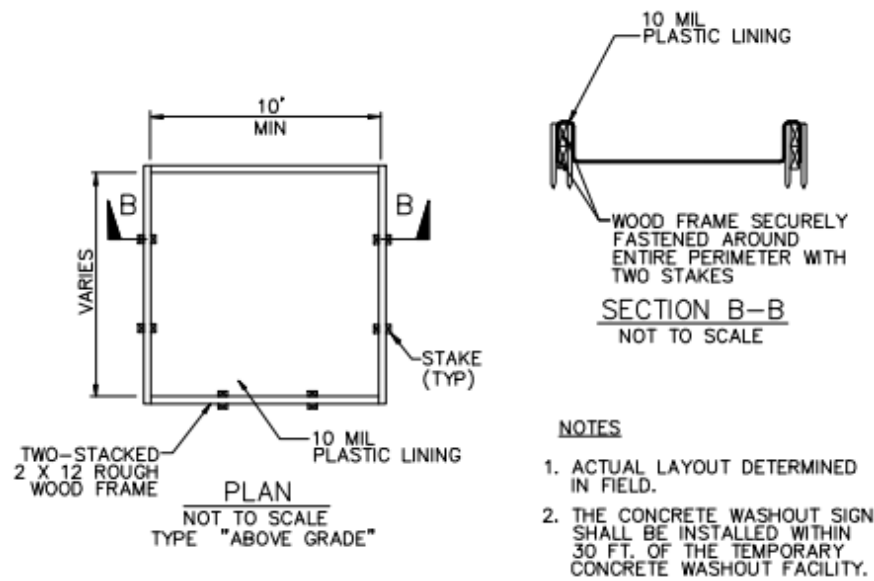


Figure 4: Above grade washout (CASQA, 2009)

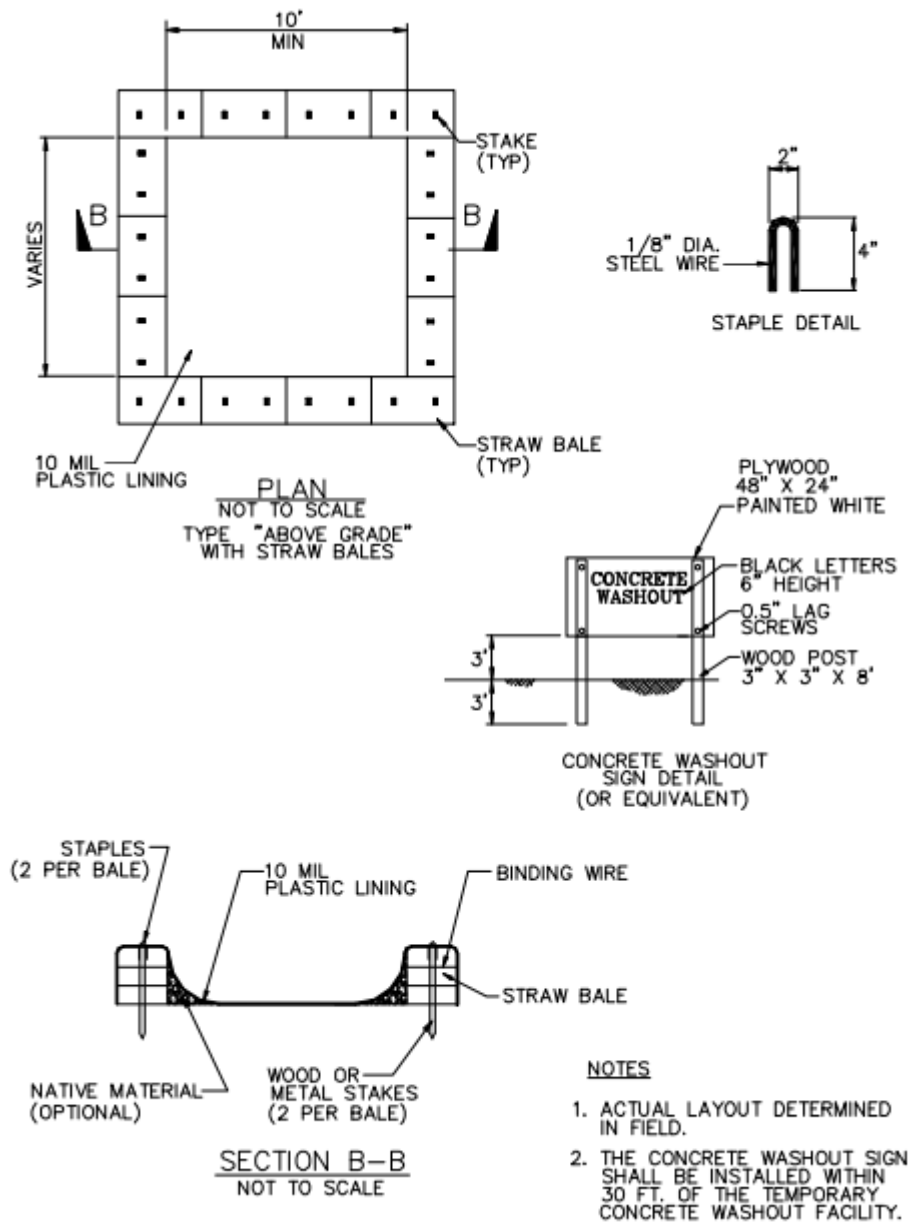


Figure 5: Above grade with straw bales washout (CASQA, 2009)

## Liners

**Hazardous Containment Liners.** Primary and secondary containment liners are manufactured for containments such as: crude oil, saltwater, fuel, hydrocarbons, manure, and acids among other hazardous commodities. Western Environmental Liner distributes liner materials with excellent hydrocarbon resistance including products such as Xr5,

which comes with a 10 year warranty against some of the strongest and most corrosive hydrocarbons. These liners are used for oil & fuel, lagoon, pit, and landfill liners. Lagoon Liners are often used for the containment of agricultural waste such as manure on farms. Today there are many restrictions when it comes to the containment of agricultural byproducts of farms and dairies. Many companies including Western Environmental's liners meet all environmental requirements. Pit Liners are used primarily for the containment of oils and fuels and range from various thicknesses of 12 mil-45 mil. Figure 6 below shows an example of hazardous conditions. (Western Environmental Liner, 2009)



Figure 6: Hazardous waste example (Western Environmental Liner, 2009)

**Non-Hazardous Containment Liners.** Non-hazardous containment liners applications include, but are not limited to recreational ponds, golf course ponds, lakes & temporary construction ponds. Construction sites require the ground to be watered down in order to prevent dirt and dust from circulating in the air. Often, water trucks travel throughout the site from a water source to the construction site. Ultimately, this can be a waste of fuel, time, and money. Construction pond liners are a great way to save money and eliminate the hassle of the water truck services. Figure 7 below shows a field example of a construction pond. (Western Environmental Liner, 2009)



Figure 7: Construction pond example (Western Environmental Liner, 2009)



**Pond Liners.** The primary prevention of water loss from storage ponds and dams are pond liners. Depending on the application, liners vary as far as the composition of the liner material goes. Some examples include polyethylene pond liners, reinforced polypropylene pond liners, and PVC pond liners. Figure 8 below shows an example of a pond that has a liner underneath the water. (Western Environmental Liner, 2009)



Figure 8: Pond example (Western Environmental Liner, 2009)

**Canal Liners.** A new, cost effective way to line canals compared to the traditional concrete is using canal liners. Traditional concrete lining can cost as much as 30 times or more compared to the cost of liners. It has been reported that more than 50% of the water in the western U.S. has been lost due to seepage which could be prevented by lining canals. Canal Lining also helps water move quickly to its destination and has several advantages for agricultural applications such as cutting down irrigation time, reducing erosion, weeds ,and of course, saving water. Figure 9 below shows an example of a canal liner. (Western Environmental Liner, 2009)



Figure 9: Example of a canal liner (Western Environmental Liner, 2009)

### **Concrete Recycling**

**Regulations.** Concrete recycling can be regulated by state environmental authorities. Regulatory issues alter from state to state and also agency to agency. For example, in

2005 California wrote legislation mandating and accepting the use of recycled concrete into new concrete. The American Society for Testing Materials (ASTM) is generally in charge on issues accepted by agencies across the U.S. Their specifications allowing for recycled aggregate use reinforces confidence in recycled concrete products. Concrete recycling allows reuse of the rubble that is usually disposed in landfills after demolitions occur. (CMRA, 2012)

**Benefits.** Recycling concrete has many benefits for not only the environmental aspect, but in some testing, it even performs at higher strength than regular concrete. It is an accepted source of aggregate into new concrete by ASTM and AASHTO. It is currently being used in concrete and asphalt products with better performance over comparable virgin aggregates. Recycled aggregates are lighter in weight per unit volume, which means less weight per cubic yard, resulting in reduced material cost and hauling. It also offers a way to reduce landfill waste streams and minimizes environmental impact. (CMRA, 2012)

**Markets.** A key issue to talk about is what markets can recycled concrete be used in? Already it has been used in: aggregate road base, ready mix concrete, soil stabilization, pipe bedding, and landscape materials. (CMRA, 2012)

**Recycling Plants.** When there is a demolition of some sort, many aspects of the project are taken into account. What kind of recycling plant is an important issue for the project due to the fact that various aspects come into play. Mobile recycling plants can be moved to various locations economically. The machines with tracks have the most mobility on site and an image can be seen in Figure 10 below. (CMRA, 2012)



Figure 10: Mobile recycling plant (CMRA, 2012)

**Testing.** Concreterecycling.org has conducted some testing from a highway project on what mixture of recycled and virgin coarse aggregate has the strongest strength. In the

scenario shown in Figure 11, the strongest was achieved with 75% recycled & 25% virgin coarse aggregate. (CMRA, 2012)

Design:	C/A Ratio:	7 Day	14 Day	28 Day
Flexual Comp:	25% RCY 75% QRY	710 PSI 4600 PSI	760 PSI NO DATA	760 PSI 5730 PSI
Flexual Comp:	50% RCY 50% QRY	640 PSI 4560 PSI	690 PSI NO DATA	700 PSI 5530 PSI
Flexual Comp:	75% RCY 25% QRY	665 PSI 4700 PSI	690 PSI NO DATA	800** PSI 6230 PSI
Flexual Target 650 PSI*				Final Design 75% RCY AGG

Figure 11: Recycled concrete testing (CMRA, 2012)

## **Concrete Mixers**

**Portable Mixers.** A concrete or cement mixer is used to combine cement, aggregate, and water to form the final concrete composition. A revolving drum is the essential of a typical mixer. For smaller work volumes, portable concrete mixers are often used so that the concrete can be made at the job site, thus giving the workers more time to use the concrete before it hardens. Figure 12 below shows and example of a portable concrete mixer.



Figure 12: Portable concrete mixer (Home Depot, 2012)

**Concrete Mixing Trucks.** Special concrete mixing transport trucks are manufactured to mix and deliver concrete out to job sites. The primary function of these trucks is that they mix and deliver at the same time. The trucks drum rotates and keeps the concrete in its liquid state through agitation. There is a spiral blade on the inside of the drum that allows this mixing to take place. Trucks have a chute to guide the concrete slurry to its desired location. Concrete pumps are used if the truck cannot get close enough to be able to use the chutes.

## PROCEDURE & METHODS

### Design Procedure

A final design was created after completion of the literature review and discussions with various professors. All 3D modeling for the project was completed using SolidWorks. The input from Dr. Stuart Styles, Dr. Andrew Holtz, Benjamin Swan, and Greg Lampman all helped build a prototype.

### Old Model

The old concrete washout that the BRAE Department had been using for their concrete classes was out of date and not visually appealing. It is pictured below in Figure 13 and at times did not seem to give the department a professional look.

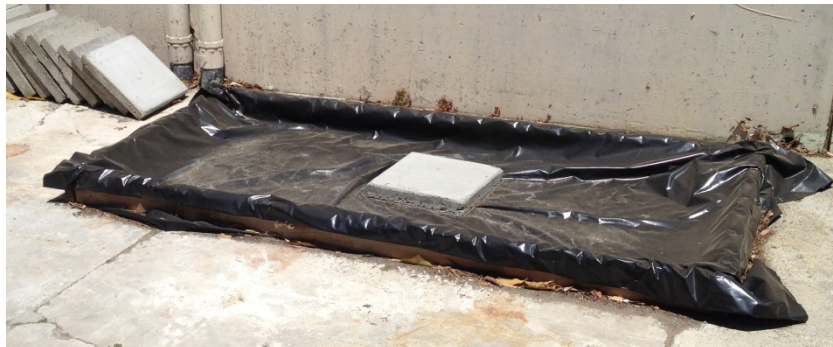


Figure 13: Old concrete washout

This model consists of a wooden frame (2 inch x 6 inch) with a plastic liner stapled over it. It is easily broken down and stored. The overall dimensions are 4 feet x 8 feet. The depth of the old model is 6 inches, thus giving the overall volume of 16 cubic feet.

### New Design Specifications

The new design had a couple of considerations and requirements to meet. The BRAE Department had an even older concrete washout bin before the model seen in Figure 13 that was 4 feet x 8 feet x 0.5 feet deep and it worked okay. It was made out of steel, similar to the new model I have created. The main problem with that bin was the fact that after concrete wash water evaporated and hardened, concrete was left over in the steel bin. This left over concrete needed to be dumped out into the Cal Poly Facilities Recycling, but in order to do that it needed to be flipped over and pounded. After the bin

was flipped over and the hardened concrete was pounded out, small amount of residue was left over on the ground, thus creating an environmental problem. Another issue with this bin was the fact that the only space close by that the concrete could be pounded out of the bin was near a storm drain according to Dr. Stuart Styles.

**Initial New Design.** The initial new design was created on Solidworks and then was emailed to the professors for further examination and feedback. As seen on Figure 14 below, the new concrete washout bin included: forklift inserts, a dumping region, and also a tool cleaning station.

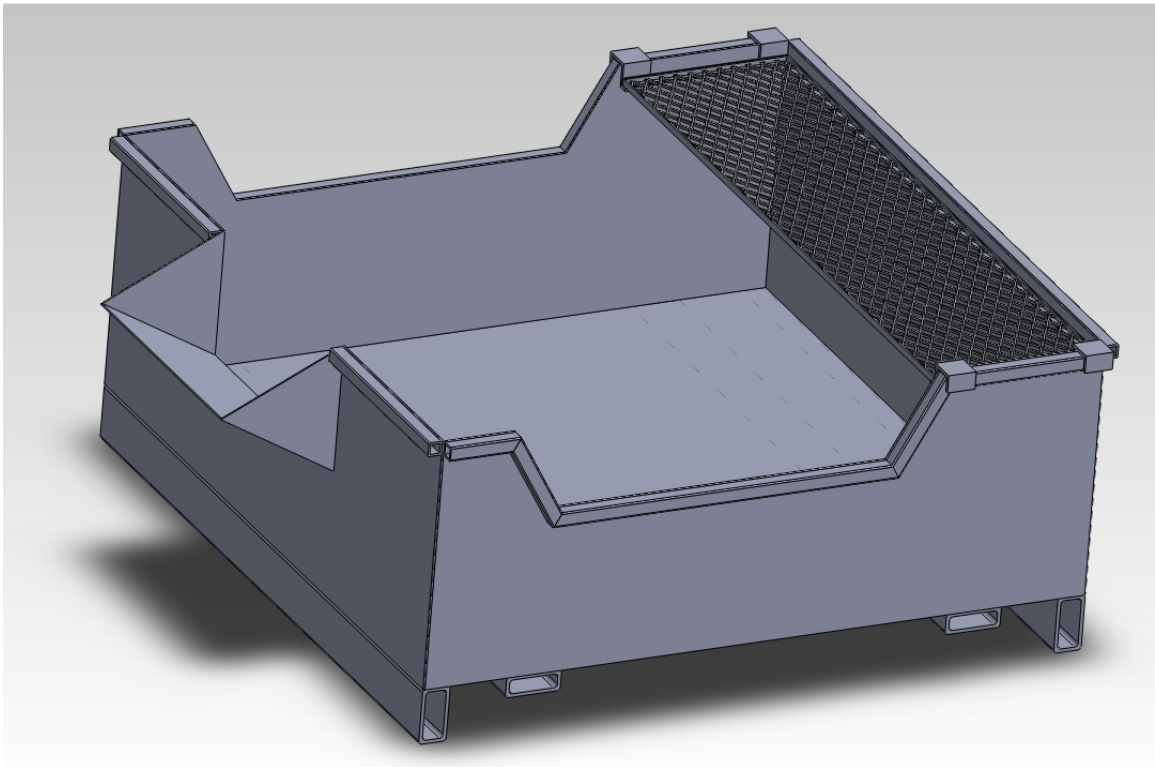


Figure 14: Initial new design

The bin dimensions were 4 feet x 4 feet, with the lowest height being 1 foot. This had 16 cubic feet of volume for standing water and concrete waste, which is plenty for the department usage. The main assembly consists of 12 gauge mild steel, with 0.5 inch x 0.5 inch square tubing around the edges. The tool cleaning mesh grate will serve as a station to place hand tools and other equipment that needs to be rinsed off. The tool cleaning station can be removed via hooks. On the other side, parallel to the tool cleaning station, you see a half-hopper looking insert. This is the location that the concrete mixers can be rinsed off at. The dimensions of the mixers were measured and made sure the slot protruded out enough to completely fit under the mixer's barrels. The



other sides were lowered so that concrete could be easily shoveled out and access would be more affected.

**Initial New Design Flaws.** It was soon witnessed that this new design had many flaws. The initial design did not have an easy way to flop out the dried up concrete and the shovel out idea was thrown out. The sides were too high as wheel barrow dumping will be a problem. A ramp idea was considered, but safety concerns with a slippery ramp ruled that idea out. After a forklift would pick up the container, it would tilt in the direction parallel to the forklift inserts, thus the hopper-like side would benefit the opposite side in relation to the forklift inserts. Feedback from Dr. Styles and Professor Greg Lampman were taken into consideration. Figure 15 below shows adjustments made by Dr. Styles and his feedback on the issues. Dr. Styles recommended that the design wall height should be dropped down so the students are not restricted by the height. He stated that one side should be used to slide the concrete with the polyurethane liner out easily.

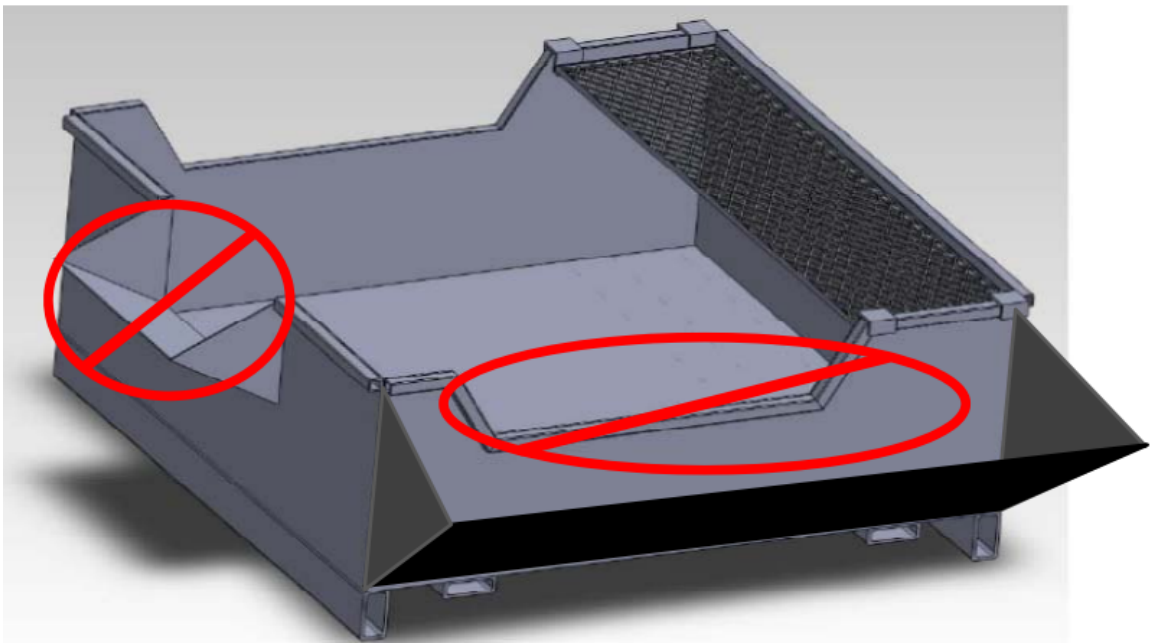


Figure 15: Adjustments from Dr. Styles

Professor Lampman also had suggestions about a more refined concrete washout system. In Figure 16, he laid out his proposal about certain changes to the initial design. The sidewall should be lowered to 0.5 feet and 4 foot x 10 foot length and width dimensions should add a larger volume for excess water to evaporate from the concrete waste. He stated that he has two lab classes back to back and the current wood box concrete washout is a bit small considering the water volume would add up due to equipment cleaning. He proposed an idea for a hook to be added to the washout container so when it

was dumped using the forklift a chain could be hooked on to ensure the whole container would not slide off the forklift. An idea for a wood block where the plastic liner could be stapled too was also added.

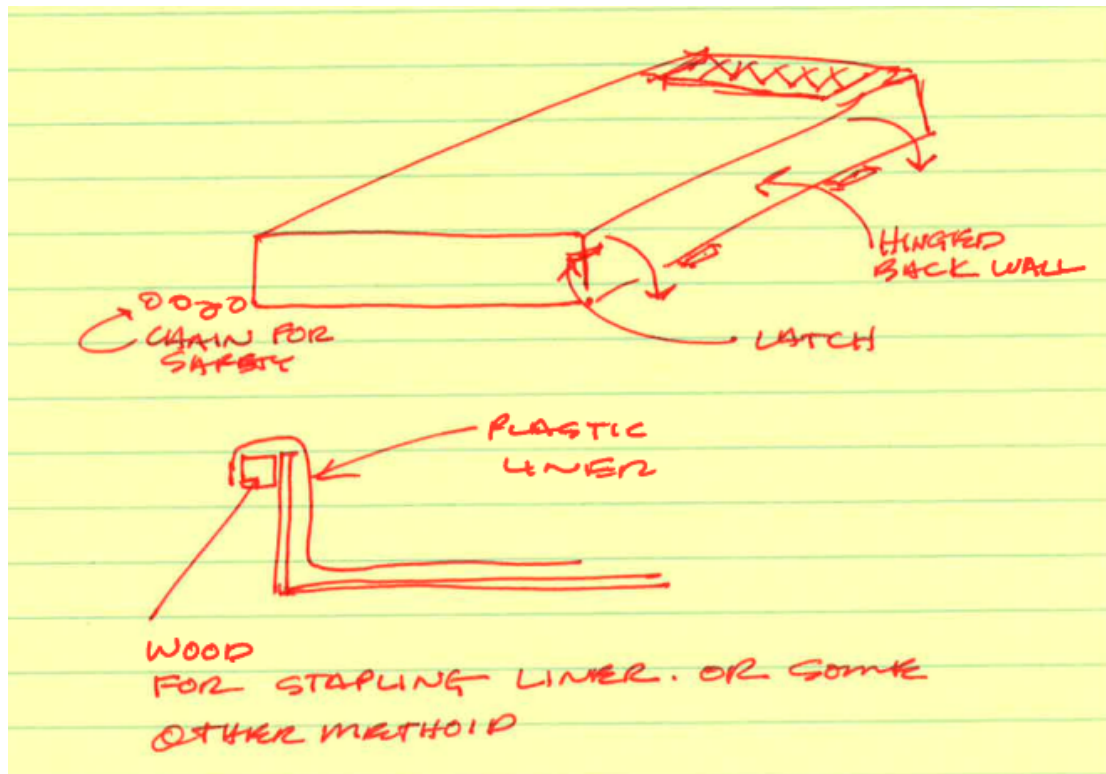


Figure 16: Adjustments from Professor Lampman

### **Final Design**

The final design consisted of the initial design with changes made to accommodate certain characteristics that benefit the users of the concrete washout system.

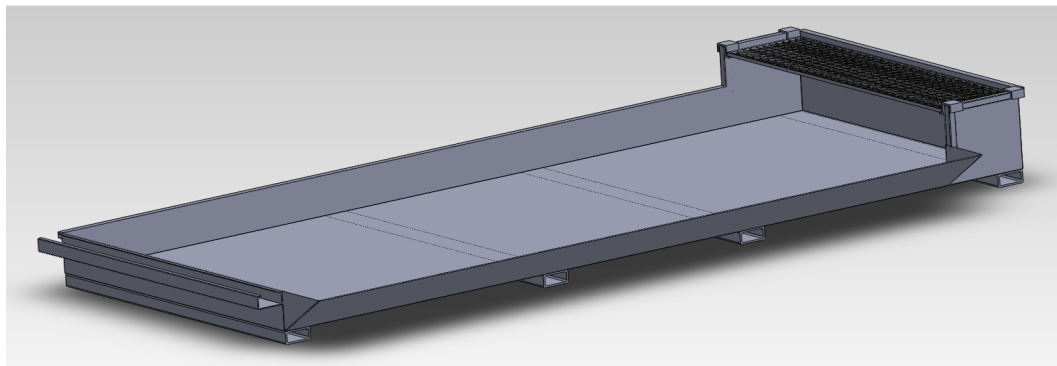


Figure 17: Final design 1



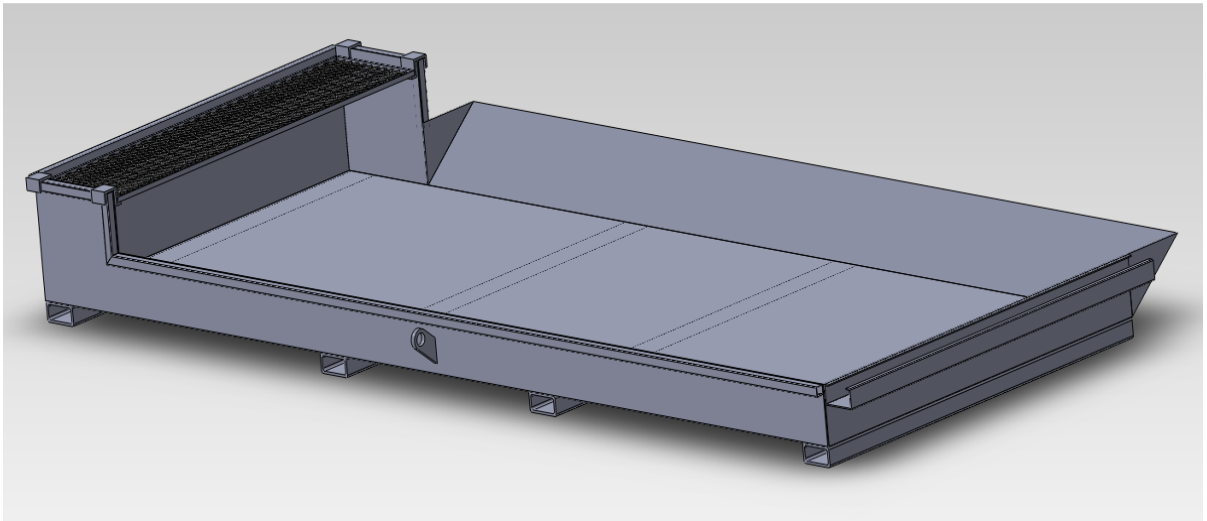


Figure 18: Final design 2

**Frame.** The frame will be made from 10 gauge steel instead of the original 12 gauge that was arbitrarily picked. 10 gauge steel is 0.1345 inches thick and 12 gauge steel is 0.1046 inches thick. The extra thickness ensures rigidity for the system as a whole. All components of the frame are to be cut using a shear or a band saw. The frame components are listed in Appendix B, with all necessary dimensions. After all the frame components are dimensioned to exact measurements, welding can occur. The welding component is very crucial due to the fact that no water can leak out of the concrete washout system. Even though there will be a liner to prevent the concrete from sticking to the steel and act as an easier way to slide out all the dried up concrete, the frame still needs to be leak free in case any water goes under the liner (as it should).

**Forklift Hook.** The forklift hook is a crucial aspect to the design due to its safety insurance. Forklifts have a latch that can hook onto any hook type object and it determined that this concrete washout bin should be equipped with a hook. It was designed to be made out of 0.5 inch steel, but this dimension was arbitrary and the actual thickness can vary depending on available scrap metal. This hook can be cut out using the plasma cutter due to its unique shape. The hook is welded on the frame as shown in Figure 19 below.

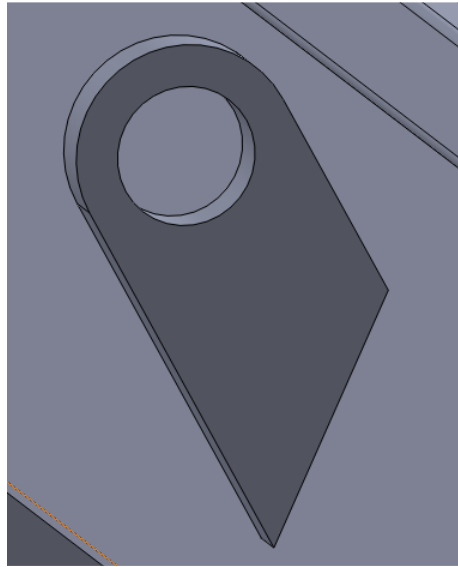


Figure 19: Forklift hook

**Forklift Inserts.** The forklift inserts are a crucial aspect to the design. The size and dimensioning of the tubing used gives the overall design height as well as its relativity to the ground. 2" x 8" x 1/4" tubing was selected for the two main forklift inserts as pictured in Figure 17 and 18. These were chosen because a 3" x 8" opening allows enough wiggle room as well as various size forklifts/reach lifts to access the bin. Based on this measurement, the two side stands/supports must be the same height so the concrete washout bin sits flush. The support stands rectangular tubing is 2" x 4" x 1/4". All four pieces of rectangular tubing is 48" in length and fully supports the concrete washout bin in equally distributing the weight placed upon them.

**Liner Holder.** An aspect of the design that was added late in the prototype is the liner holder. As seen in Figure 20 below, this piece of 2" x 4" x 1/4" tubing is to be sliced on the top end to allow a wood 2" x 4" to slide into it. With the wood in place, the liner can be stapled to the wood and ultimately stay secure. The wood can be taken out if it needs to be replaced eventually as usage on the actual washout bin occurs. The top segment that needs to be cut out will be 0.5" from each edge, so overall 3" will be cut out of the 4" width of the tubing. The liners come in rolls so the length can be adjusted and cut to meet exact specifications each time the washout is used. Eventhough water may get around the edges of the liner depending on the application, the tank is waterproof. The liner's primary usage will be for easy cleanup once the water has evaporated in the washout and the dried up concrete was just slide out with the liner. Exact dimensioning is available in Appendix B.

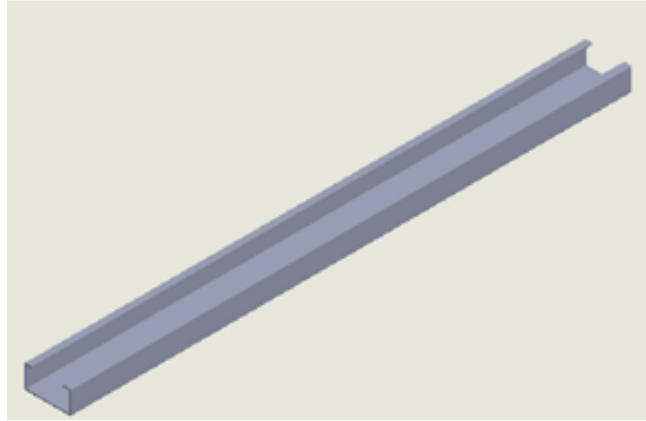
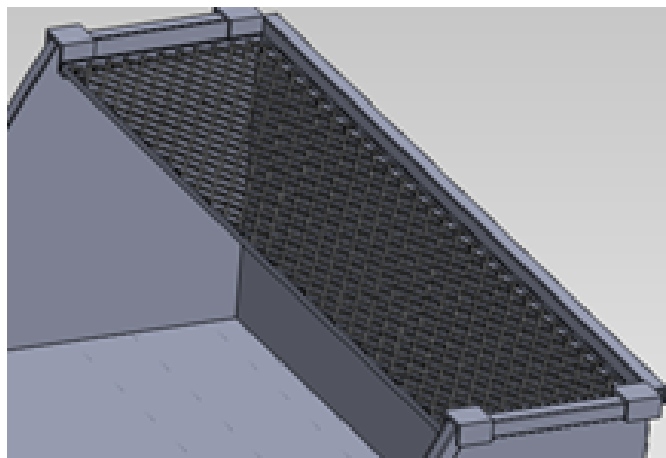


Figure 20: Liner holder

**Tool Rack.** The tool rack is a component that will serve as a spot to place hand tools and other small equipment so they can be hosed down. The concrete will slide off the tools and into the bin. A key feature about this tool rack is that it can be removed easily. Four hooks are assembled on each corner and these hook latch onto the square tubing. Exact dimension of the hooks are located in Appendix A. The tool rack is to be assembled out of angle iron for the edges and round stock for the parallel and perpendicular bars.  $\frac{1}{4}$ " round stock will be cut at lengths of 4 feet and 1 foot. The 4 foot sides are obviously parallel to the forklift inserts (long way) and the 1 foot sides are perpendicular to that. Everything is to be welded after dimensioning is exact.



## COST ANALYSIS

### Material Cost

The estimated material cost was obtained from supplies bought from B&B Metals in Santa Maria. The BRAE Department purchases all of their steel from B&B and it seemed adequate to obtain information from them. A phone call was made to B&B, thus the values are not arbitrary but instead are actual values. A description of the item, use, size, and quantities are listed below in Table 1.

Table 1: Material cost

<u>Material List</u>							
Item #	Description	Use	Size	Qty.	\$ / Unit Length	Cut Charge	Item Total
1	10 Gauge Sheet Metal	Main Structure	6' x 12'	1	-	\$ -	\$ 297.00
2	Rectangular Tubing HR	Fork Lift Pockets	3" x 8" x 1/4" x 1'	9	\$ 15.00	\$ 10.00	\$ 145.00
3	Rectangular Tubing HR	Stands / Supports	3" x 4" x 1/4" x 1'	13	\$ 8.72	\$ 10.00	\$ 123.36
4	Square Tubing HR	Integrity Around Edges	1" x 1" x 1/16" x 20'	2	\$ 16.60	\$ -	\$ 33.20
5	Round Stock	Tool Cleaning Station	1/4" x 20'	3	\$ 5.00	\$ -	\$ 15.00
6	Angle Iron	Tool Cleaning Station	1/2" x 1/2" x 1/8" x 20'	1	\$ 8.00	\$ -	\$ 8.00
<b>Grand Total =</b>							<b>\$ 621.56</b>

A cut charge of \$10.00 is something B&B incorporates in their pricing if certain items are bought in a size less than standard. For example, the rectangular tubing comes in a standard size of 20 feet, but for the needs of this project less is needed, thus the cut charge comes into play. As shown in Table 1, the grand total on materials, which is all steel, for the concrete washout bins comes out to \$621.56.

## Labor Cost

The second cost for the project is the labor cost in order to assemble everything. Everything must be cut, dimensioned, and then welded together. The 10 gauge steel plate can be cut using the shear press. All of the tubing, round stock, and angle iron can be cut using a band saw. Cutting cost incorporates: total cutting time, total advance time, and total deburring time; all of which are estimates. Welding cost incorporates how much time a certified welder takes to do the job multiplied by their hourly rate. An average shear press / band saw operator costs approximately \$70 per hour and average welders cost approximately \$90 per hour of work.

Table 2: Labor cost

<u>Estimated Labor Cost Per Concrete Washout Bin Manufactured</u>						
Item #	Description	Use	Size	Cut Charge	Weld Charge	Item Total
1	10 Gauge Sheet Metal HR	Main Structure	6' x 12'	\$ 38.88	\$ 133.20	\$ 172.08
2	Rectangular Tubing HR	Fork Lift Pockets	2" x 8" x 1/4"	\$ 4.28	\$ 66.60	\$ 70.88
3	Rectangular Tubing HR	Stands / Supports	2" x 4" x 1/4"	\$ 4.28	\$ 66.60	\$ 70.88
4	Square Tubing HR	Structural Integrity Around Edges	1" x 1" x 1/16" x 20'	\$ 7.72	\$ 41.63	\$ 49.35
5	Round Stock	Tool Cleaning Station	1/4" x 20'	\$ 4.30	\$ 24.98	\$ 29.28
6	Angle Iron	Tool Cleaning Station	1/2" x 1/2" x 1/8" x 20'	\$ 3.92	\$ 16.65	\$ 20.57
					<u>Grand Total =</u>	<u>\$ 413.03</u>

The values for the cut charge incorporate the number of cuts that have to be made as well as the length of the cuts that have to be made. Table 2 above shows that the main frame cut charge is the largest due to the size of the cuts. The rectangular tubing will come in 9 and 13 foot lengths as ordered from B&B. The welding for this project is extensive and not only time consuming, but a large chunk of the labor goes into that. Table 1 and 2 show that this prototype costs a little over \$1000 to manufacture.

## **DISCUSSION**

Since the overall design has not been built or tested, there may be some flaws and minor adjustments that need to be made. These adjustments are necessary as the design actually gets fabricated. This concrete washout prototype will help the labs associated with concrete that takes place in the Agricultural Engineering Annex. The new concrete washout bin will add a larger footprint as compared to the older model and in doing this; it is also more visually appealing. This container, being constructed all out of steel, is extremely durable and should last a while.

The topic of wastewater pollution is rapidly growing and is prevalent in society today. Concrete waste water is extremely toxic and an ethical code as a human being is to be productive and contribute to the greater good of society as a whole.

## **RECOMMENDATIONS**

The design for this concrete washout system had the main goal of making sure no concrete wastewater runs off into the storm drains. At the same time certain issues regarding size and dumping access were addressed in creating the new prototype. The cost analysis gives the impression that if there was a way to optimize certain labor costs, the price per unit of the concrete washout system could go down.

The whole idea of the prototype can always be modified and certain aspects of it can be changed without modifying the core.

## REFERENCES

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<[http://www.concretewashout.com/pages/industry\\_problems/concrete\\_washwater](http://www.concretewashout.com/pages/industry_problems/concrete_washwater)>.

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< <http://www.concreterecycling.org/why.html>>.

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<[http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?productId=202565557&storeId=10051&langId=1&catalogId=10053&ci\\_src=14110944&ci\\_sku=202565557&cm\\_mmc=shopping-\\_googlebase-\\_D22X-\\_202565557](http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?productId=202565557&storeId=10051&langId=1&catalogId=10053&ci_src=14110944&ci_sku=202565557&cm_mmc=shopping-_googlebase-_D22X-_202565557)>.

Stuart, Styles. Concrete Washout Procedures Omar Adina. 17 April 2012.

Western Liner. Pit Liners. 2009. 31 May 2012 <<http://www.westernliner.com/pit-liners.html>>.



## **APPENDIXES**

## **APPENDIX A**

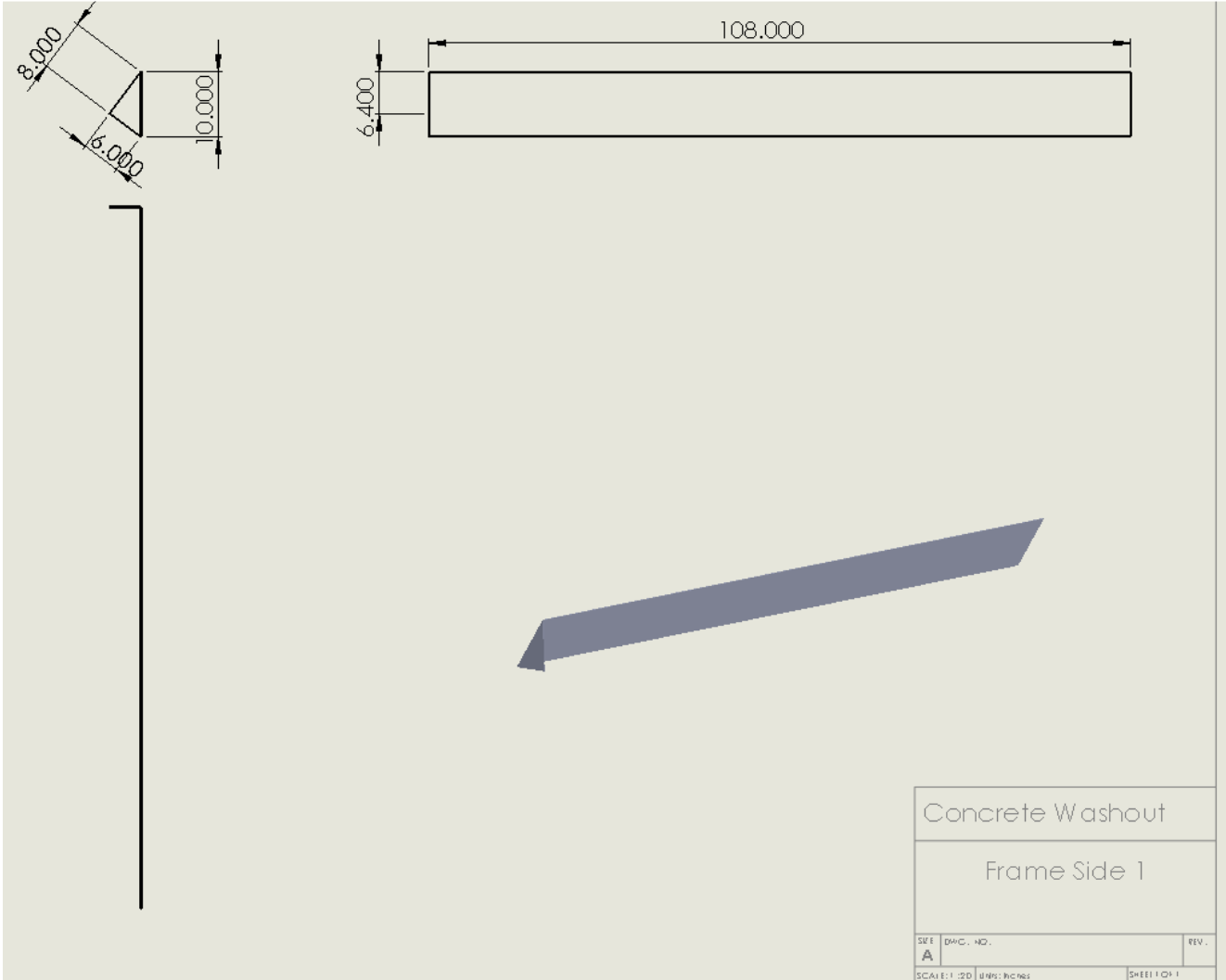
### **Project Contract**

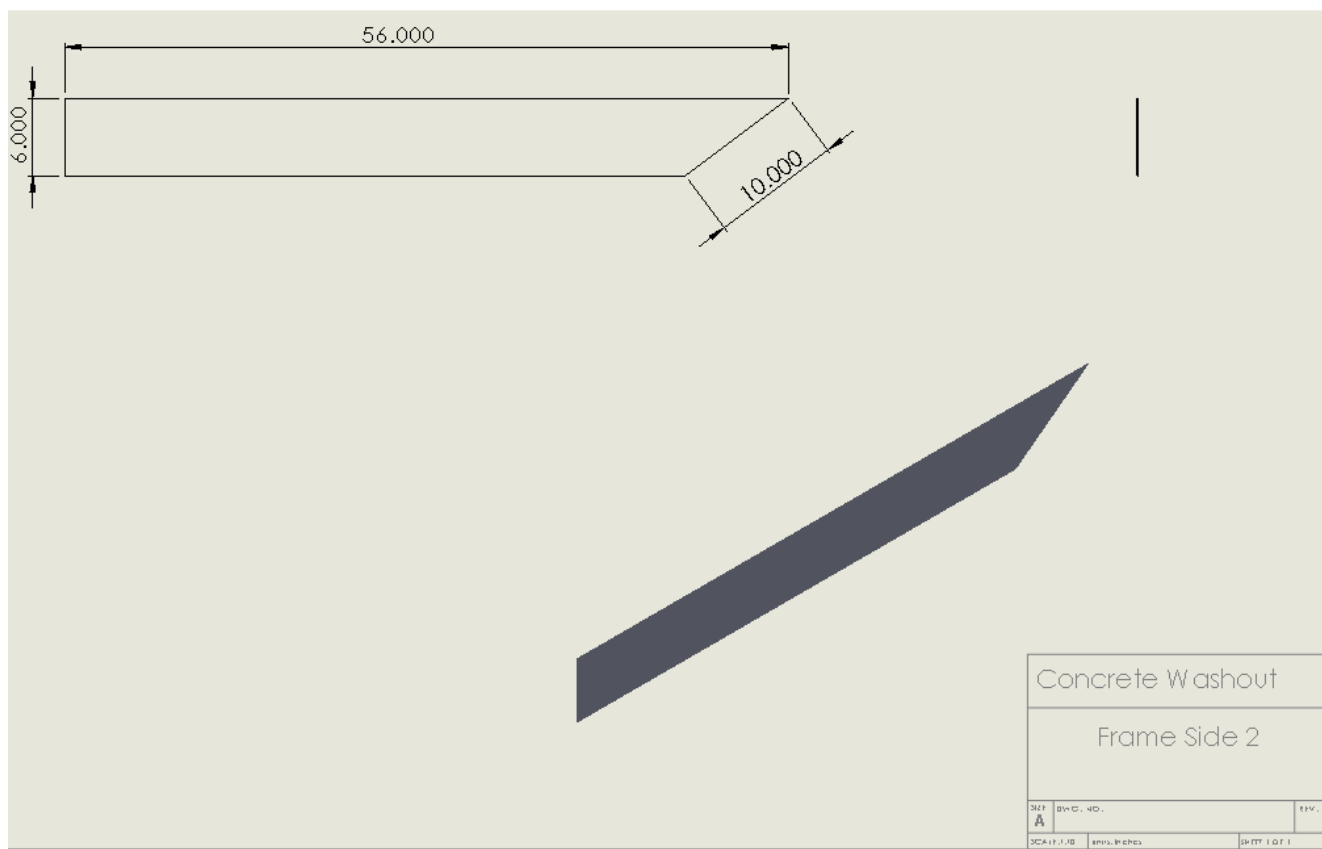
California Polytechnic State University		4-Jun-11
BioResource and Agricultural Engineering Department		Adina, Omar
<b>BRAE Senior Project Contract</b>		003680998 <b>BRAE</b>
<b>Project Title</b>		
Implementations, Design, and Cost Analysis of Concrete Washout System		
<b>Background Information</b>		
With current standards regarding urban runoff pollution increasing, the proper pollution prevention practices are steadily increasing. Materials washed into the storm drain have a direct impact on local waterways and habitat living in that environment. Cal Poly's BRAE Department has been actively looking to create a more stable/effective concrete washout system for the concrete classes which take place in front of the Agricultural Engineering Annex.		
<b>Statement of Work</b>		
The first phase of this senior project will be to accumulate information regarding concrete washout systems along with certain constraint specifications about storm water runoff. The second phase will consist of the actual washout design prototype. The third phase will be constructing a full cost analysis of the system in order to determine optimal materials and to determine the overall labor and material cost. This system will be hypothetically mass produced.		
<b>How Project Meets Requirements for the BRAE Major</b>		
<b>Major Design Experience</b> - The botanic fruit vine chopper will incorporate fundamental components of material properties and machine design, economic feasibility, social and environmental impacts, as well as many other components that will impact the component.		
Establishment of objectives and criteria	Project objectives and criteria are established to meet the needs and expectations the Cal Poly BRAE Department as well as staying within the environmental regulations.	
Synthesis and analysis	The project will incorporate weight analysis, steel properties considering welding standards and metal thicknesses. The most cost efficient design will be modeled with the cost analysis.	
Construction, testing and evaluation	The concrete washout system will be implemented and designed by Omar Adina.	
Incorporation of applicable engineering standards	The project will utilize ASTM for metal variations and types, CASQA and the EPA for environmental regulations	
Capstone Design Experience - The engineering design project will be based on the knowledge and skills acquired in earlier coursework (major, support and/or GE courses)		
Incorporates knowledge/skills from these key courses	BRAE 129 Lab Skills/Safety, BRAE 133 Engineering Graphics, BRAE 151 AutoCAD, BRAE 234 Mechanical Systems, BRAE 421/422 Equipment Engineering, BRAE 433 Concrete Design, ME 211/212 Engineering Statics/Dynamics, CE 204/207 Strength of Materials, ENG 149 Technical Writing	

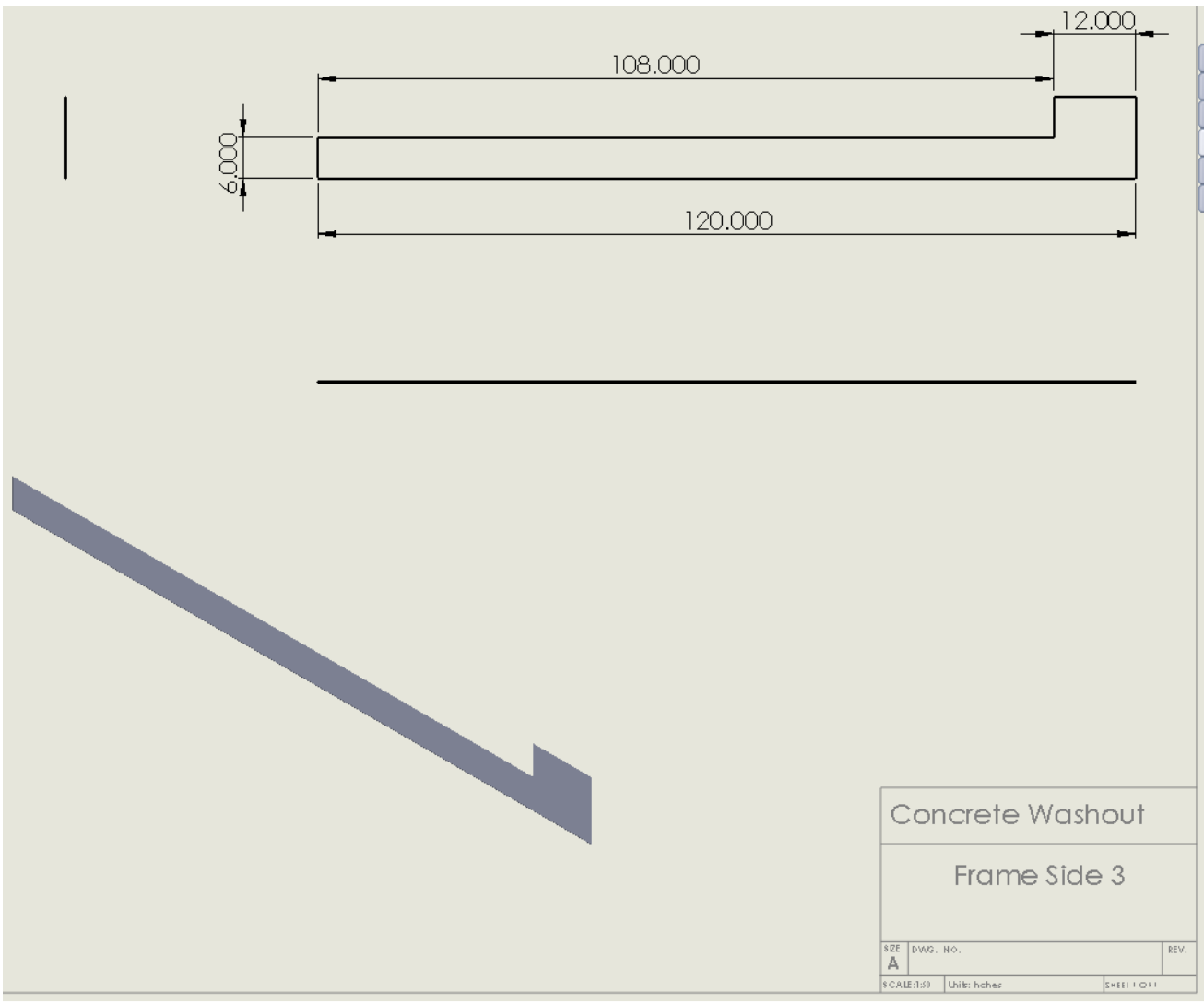
Design Parameters and constraints - The project should address a significant number of the categories of constraints listed below.	
Physical	The steel frame for the concrete washout must fit in an appropriate location, hold a certain volume of water/concrete, determined by the BRAE Department. It must have forklift inserts as well as easy dumping access.
Economic	The cost of this operation should be as minimal as possible due to the actual design production will be paid for by the BRAE Department.
Environmental	This project has major environmental implications. Concrete construction residue consists from washing equipment such as pumps, mixers, chutes, hand tools, wheelbarrows, etc. Pollution from runoff into our storm drains has a huge environmental impact.
Sustainability	This project will hopefully establish a permanent concrete washout system instead of the current wooden temporary one.
Manufacturability	This product will be designed to be mass produced and most economically efficient.
Health and Safety	The washout system must be free of any safety regulations including: sharp edges, unstable positions, etc. A safety hook will be designed so it does not slide off the forklift easily.
Ethical	Helping out the department by being more environmentally compliant as well as aesthetically appealing.
Social	N/A
Political	N/A
Aesthetic	The finished machine will be spray painted with high quality automotive paint to provide a professional appearance. Multiple safety stickers will be put in place for visibility and attention.
Productivity	N/A
Other	

## **APPENDIX B**

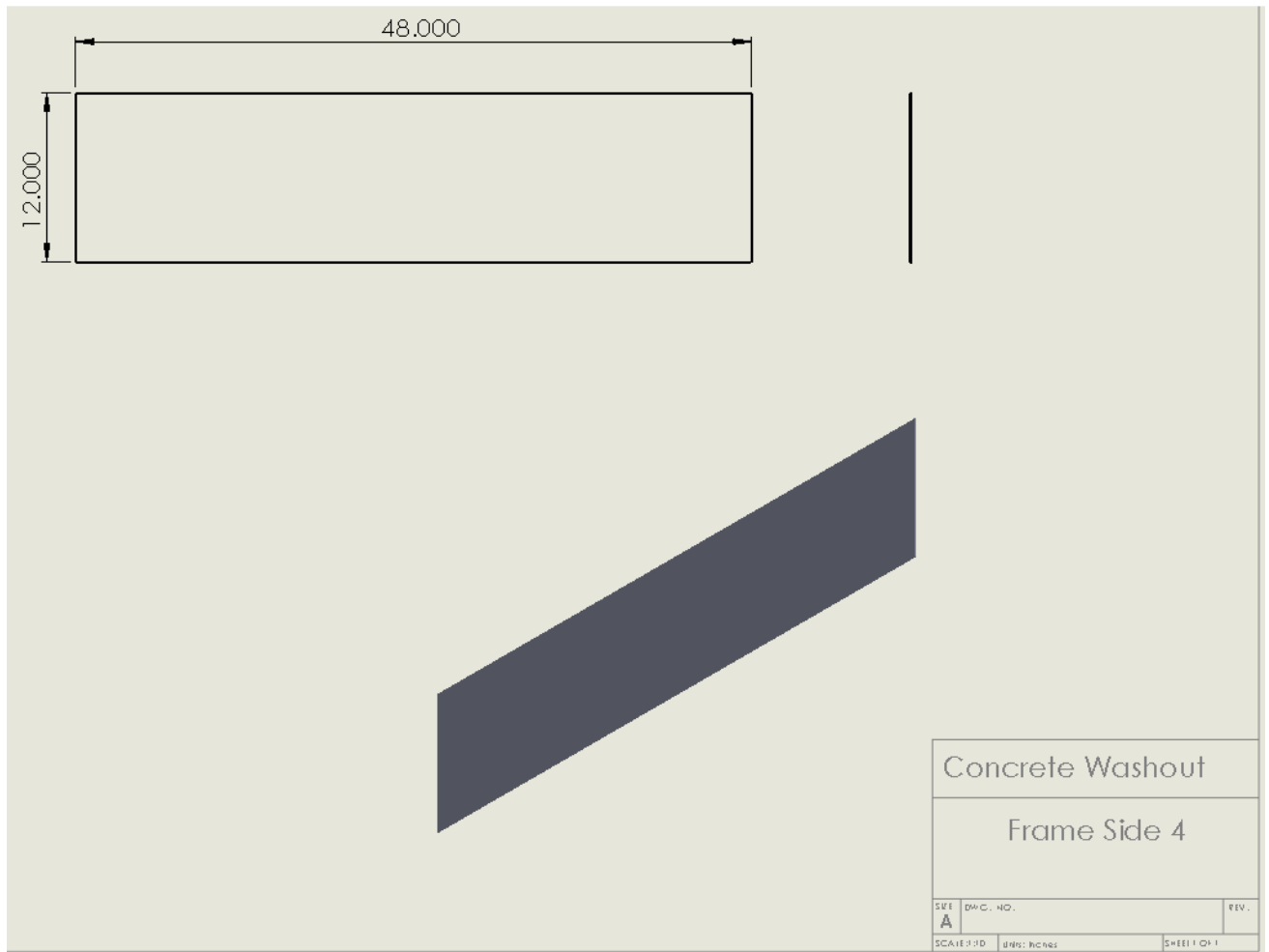
### **SolidWorks Drawings of Components**

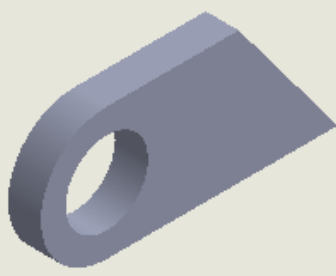
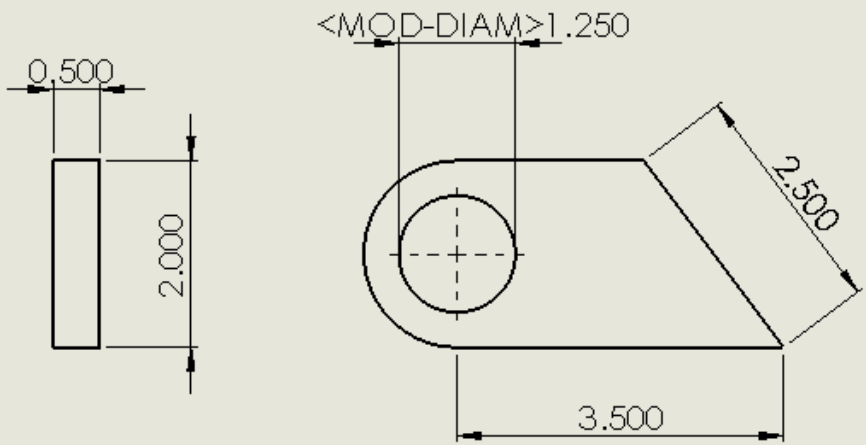






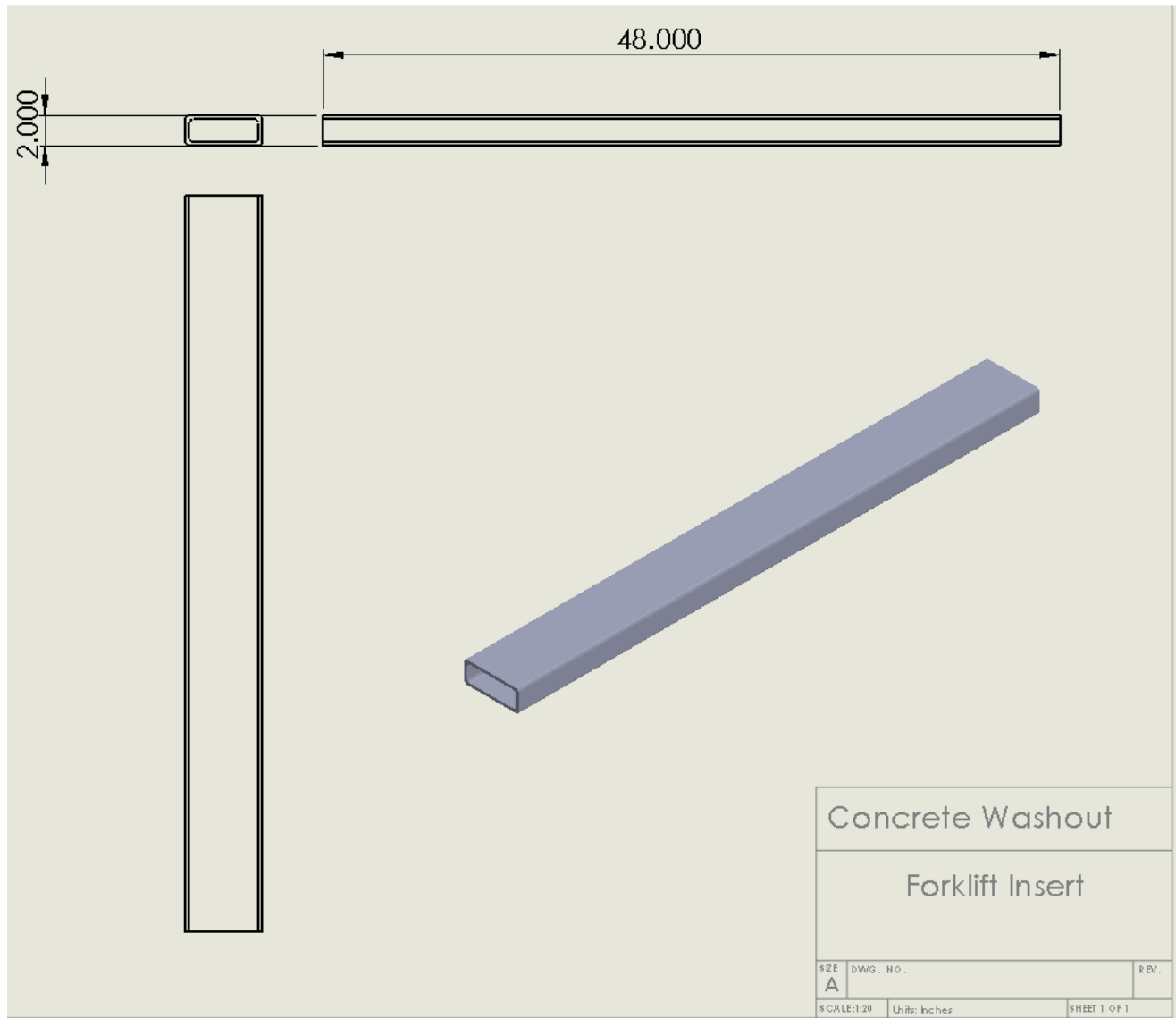


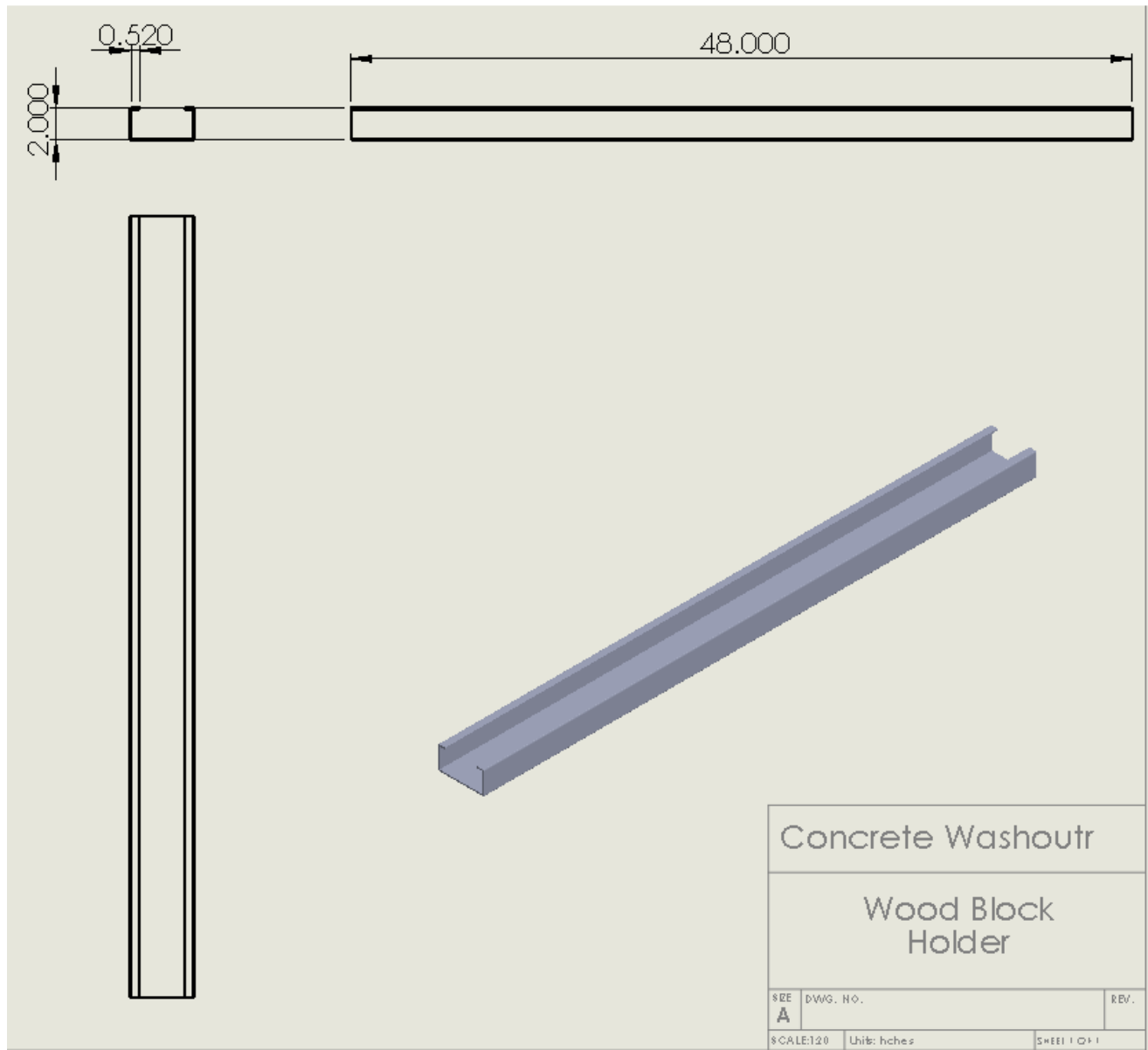


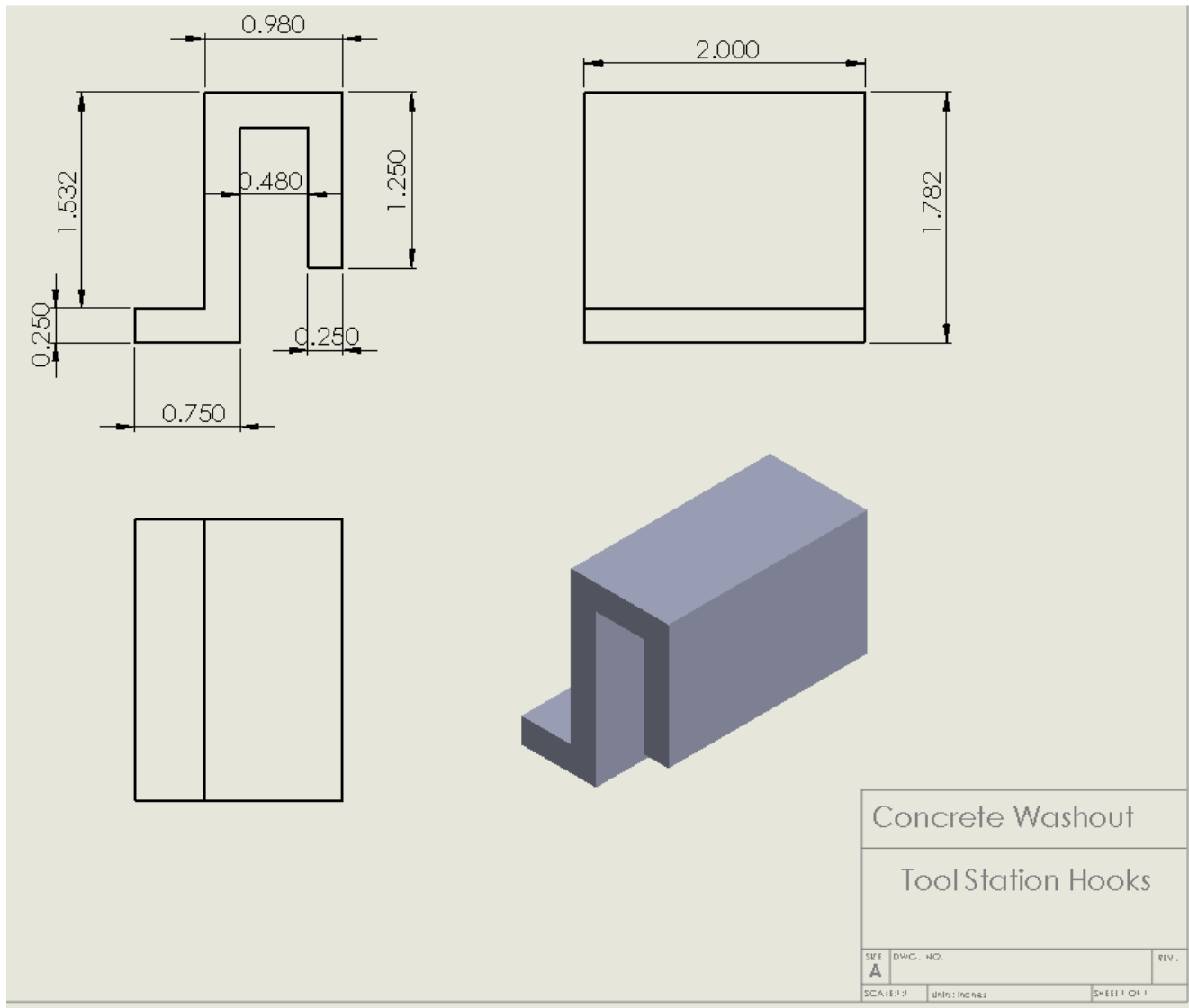


Concrete Washout  
Safety Hook

SEE A	DWG. NO.	REV.
SCALE: 2	units: inches	SHEET 1 OF 1







## APPENDIX C

### **Emails from Professors**

**RE: Concrete Classes**

Inbox x

**Stuart W. Styles** sstyles@calpoly.eduMar  
2

to Omar, ajholtz, Benjamin

Good question.

I think Dr. Holtz uses it once a year but I think BRAE121 (Dr. Swan) uses it 3 times per year.

-----Original Message-----

From: Omar Adina [mailto:[oadina@calpoly.edu](mailto:oadina@calpoly.edu)]

Sent: Monday, February 27, 2012 11:59 AM

To: Stuart W. Styles

Subject: Concrete Classes

Hi Dr. Styles,

I am doing my Senior Project on designing and implementing a more permanent concrete washout bin for the department. I had a question regarding which classes other than BRAE 433 (Fall) have concrete labs in front of Lab 1? I just wanted to get a rough estimate as to how often this new washout bin will be used throughout 1 school year. This will help my Solid Works drawings as the size of the design will depend on usage.

Thanks,

Omar

**Andrew Holtz** ajholtz@calpoly.eduMar  
2

to Stuart, Omar, Benjamin

We would use the washout bin twice in the Fall quarter for my BRAE 342 (Agricultural Materials) course-  
AJH

Dr. Andrew J. Holtz, PE  
Assistant Professor

BioResource & Agricultural Engineering  
Cal Poly State University  
San Luis Obispo, CA 93407

P - [805.756.2385](tel:805.756.2385)  
F - [805.756.2626](tel:805.756.2626)  
[ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)



**Benjamin Grant Swan** [bswan@calpoly.edu](mailto:bswan@calpoly.edu)

Mar  
2

to ajholtz, Stuart, Omar

Here is the summary of what I know about the concrete clean out (with Dr. Holtz's info). Greg Lampman teaches BRAE 121. I am unsure if BRAE 129 (Weisenberger) uses the washouts in the fall?...

Fall  
BRAE 121 (2 labs - same week)  
BRAE 342 (2 labs - different weeks)  
AgEd 522 (1 lab)

Winter  
BRAE 121 (2 labs - same week)  
BRAE 481 (1 lab - usually take to site - if portable - this year @ dairy)

Spring  
AgEd 522 (1 lab)

I have no idea IF the labs between classes are during the same week, that might affect capacity of the new and improved washout system.

Hope this helps,

Ben





**Stuart W. Styles** [ssstyles@calpoly.edu](mailto:ssstyles@calpoly.edu)

Mar  
2

to gweisenb, Greg, Benjamin, ajholtz, Omar

All-

I added my info into the list below. I use the washout in the 3rd week of Fall Quarter. I will cc: Gary. I am not sure if he does a concrete lab. Maybe everyone could add the week they do the lab...

Fall

BRAE 121 (2 labs - same week)

BRAE 342 (2 labs - different weeks)

BRAE 433 (1 lab - 3rd week)

---

AgEd 522 (1 lab)

Winter

BRAE 121 (2 labs - same week)

BRAE 481 (1 lab - usually take to site - if portable - this year @ dairy)

Spring

AgEd 522 (1 lab)

Stuart

-----Original Message-----

From: Benjamin Grant Swan [mailto:[bswan@calpoly.edu](mailto:bswan@calpoly.edu)]

Sent: Friday, March 02, 2012 11:35 AM

To: [ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)

Cc: Stuart W. Styles; Omar Adina

Subject: Re: Concrete Classes

Here is the summary of what I know about the concrete clean out (with Dr. Holtz's info). Greg Lampman teaches BRAE 121. I am unsure if BRAE 129 (Weisenberger) uses the washouts in the fall?...

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BRAE 121 (2 labs - same week)

BRAE 342 (2 labs - different weeks)

AgEd 522 (1 lab)

Winter  
 BRAE 121 (2 labs - same week)  
 BRAE 481 (1 lab - usually take to site - if portable - this year @ dairy)

Spring  
 AgEd 522 (1 lab)

I have no idea IF the labs between classes are during the same week, that might affect capacity of the new and improved washout system.

Hope this helps,

Ben

----- Original Message -----

From: "Andrew Holtz" <[ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)>  
 To: "Stuart W. Styles" <[sstyles@calpoly.edu](mailto:sstyles@calpoly.edu)>, "Omar Adina" <[oadina@calpoly.edu](mailto:oadina@calpoly.edu)>  
 Cc: "Benjamin Grant Swan" <[bswan@calpoly.edu](mailto:bswan@calpoly.edu)>  
 Sent: Friday, March 2, 2012 10:25:19 AM  
 Subject: RE: Concrete Classes

We would use the washout bin twice in the Fall quarter for my BRAE 342 (Agricultural Materials) course- AJH

Dr. Andrew J. Holtz, PE  
 Assistant Professor

BioResource & Agricultural Engineering  
 Cal Poly State University  
 San Luis Obispo, CA 93407

P - [805.756.2385](tel:805.756.2385)  
 F - [805.756.2626](tel:805.756.2626)  
[ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)

-----Original Message-----

From: Stuart W. Styles [mailto:[sstyles@calpoly.edu](mailto:sstyles@calpoly.edu)]  
 Sent: Friday, March 02, 2012 10:13 AM  
 To: 'Omar Adina'  
 Cc: [ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu); 'Benjamin Grant Swan'  
 Subject: RE: Concrete Classes

Good question.

I think Dr. Holtz uses it once a year but I think BRAE121 (Dr. Swan) uses it 3 times per year.

-----Original Message-----

From: Omar Adina [mailto:[oadina@calpoly.edu](mailto:oadina@calpoly.edu)]  
 Sent: Monday, February 27, 2012 11:59 AM

To: Stuart W. Styles  
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Thanks,

Omar

--

Dr. Ben Swan  
Assistant Professor - Teacher Educator  
Agricultural Education & Communication Department  
College of Agriculture, Food, and Environmental Sciences  
California Polytechnic State University - San Luis Obispo  
Office Phone#[805-756-2401](tel:805-756-2401)

**Greg Lampman** [glampman@calpoly.edu](mailto:glampman@calpoly.edu)

Mar  
2

to Stuart, Benjamin, ajholtz, gweisenb, Omar

All,

FYI. Winter quarter spoils from I think BRAE 121 only is still sitting near Lab 1. That shows the solids left after evaporation. With two labs back to back washing out 6 mixers and equipment, volume of water is much greater than the solids. Not sure of the quantity of water used, but the water never reaches the storm drain. The last few years I have reduced the design mix to one cu. Ft. from 2 cu. Ft. so the waste is very small. It would be good if the containment could hold the liquids so it would evaporate and not run out. The list below is correct for BRAE 121.

---

-----Original Message-----

From: Stuart W. Styles [<mailto:sstyles@calpoly.edu>]

Sent: Friday, March 02, 2012 12:14 PM

To: 'Benjamin Grant Swan'; [ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu); [gweisenb@calpoly.edu](mailto:gweisenb@calpoly.edu); 'Greg

Lampman'  
Cc: 'Omar Adina'  
Subject: RE: Concrete Classes

All-

I added my info into the list below. I use the washout in the 3rd week of Fall Quarter. I will cc: Gary. I am not sure if he does a concrete lab. Maybe everyone could add the week they do the lab...

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BRAE 433 (1 lab - 3rd week)  
AgEd 522 (1 lab)

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BRAE 121 (2 labs - same week)  
BRAE 481 (1 lab - usually take to site - if portable - this year @ dairy)

Spring  
AgEd 522 (1 lab)

Stuart

-----Original Message-----

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Sent: Friday, March 02, 2012 11:35 AM  
To: [ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)  
Cc: Stuart W. Styles; Omar Adina  
Subject: Re: Concrete Classes

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I have no idea IF the labs between classes are during the same week, that might affect capacity of the new and improved washout system.

Hope this helps,

Ben

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 To: "Stuart W. Styles" <[sstyles@calpoly.edu](mailto:sstyles@calpoly.edu)>, "Omar Adina" <[oadina@calpoly.edu](mailto:oadina@calpoly.edu)>  
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 To: 'Omar Adina'  
 Cc: [ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu); 'Benjamin Grant Swan'  
 Subject: RE: Concrete Classes

Good question.

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Thanks,

Omar

## RE: Concrete Washout Bin Prototype



**Stuart W. Styles** sstyles@calpoly.edu

Apr  
27

to Omar, Bryce, Andrew, Greg, Benjamin, Shaun, Richard, gweisenb

Omar-

Thanks for the update. That is a nice drawing.

I think the best way to give you comments is to let you know what we used to have and compare your design to the old strategies.

Option A: The current strategy is to use to make a 4ft x 8ft box with 2x6s and plastic. This is simple and easy to use. Doesn't look very neat but it easy to bring the reachlift down and dispose of the concrete waste and take it to the Cal Poly Facilities Recycling. It is located at the south end of the bins near the ivy. It is about 100 ft away from a storm drain. Cal Poly Facilities asked BRAE to change the location due to water quality issues.

Option B: The old concrete pan was in place for quite awhile. The pan was 4ft x 8ft x 0.5 ft deep. It worked okay. The main problem was that we needed space to flip it in order to remove the concrete. The only place where there was plenty of room was near the storm drain.

Option C: New design by Omar.

It looks like it is about 1/2 the area of the last ones. I realize that you increased the depth to get the extra volume. There are 3 or four misers to wash out and the small work space will create a time constraint during lab.

- The older options are lower. It was nice because the students could easily lift the mixers into the steel pan to wash out.
- The new design doesn't look like there is an easy way to flip it to pop the hardened concrete.
- I am not sure what the shovel access is for? To shovel out the concrete? That probably will not work.

I think that you need to change the design where there is a larger area

available, say 4ft x 8ft. I would drop the walls down so the students are not restricted by the height. I would change the wall design so that one side can be used to slide the concrete out. I am attaching a simple sketch with the suggestions. We could then bring the reachlift and pick up the bin and tilt the forks forward to dump the concrete. I am not sure why you have included the walkway.

-----Original Message-----

From: Omar Adina [mailto:[oadina@calpoly.edu](mailto:oadina@calpoly.edu)]

Sent: Friday, April 27, 2012 12:19 AM

To: Stuart W. Styles; Andrew Joseph Holtz; Greg Lampman; Benjamin Grant

Swan; Shaun F. Kelly

Cc: Bryce A. Dafonte

Subject: Concrete Washout Bin Prototype

Hi All,

I have attached a few screen shots of the concrete washout prototype. Currently the bin is designed as 48" x 48", with the lowest height being 12". This has a 16 cubic foot footprint for standing water and concrete wastes, which is plenty for our labs. The main assembly consists of 12 gauge mild steel with 1/2" x 1/2" square tubing around the edges. The square tubing is aesthetic as well as helping maintain the strength of the bin as it will receive much abuse around the edges. As shown in the pictures, there is a mesh grate on one side. This mesh grate will serve as a spot to place hand tools and other equipment that needs to be rinsed off. The mesh grate is removable via hooks. On the other side (parallel to the mesh grate) you see a half-hopper looking insert. This is a location that the concrete mixers can be rinsed at. The dimensions of the mixers were measured and made sure the slot protruded out enough to completely fit under the mixer's barrels. The other two sides were designed so easier dumping could be possible. They are 12" high at the centers and allow for easier shoveling access in the bin. There are forklift inserts on the bottom as shown.

I wanted to see what kind of feedback you guys had on any part of the design. The design can still be modified. I wanted to estimate the exact amount of steel, because it effects the size sheet that is purchased, thus altering the fabrication process. The goal is to order parts next week so we can put it together before the quarter ends.

Best regards,

-Omar

 **wash1.pdf**  
46K [View](#) [Download](#)



Greg Lampman [glampman@calpoly.edu](mailto:glampman@calpoly.edu)

Apr

to Omar, Stuart

Omar,

First of all thank you for working on the wash out bin as it is needed.

1. The tool cleaning area is a good idea and is needed.
2. I think we need lower sides as wheelbarrow dumping will be a problem, or a ramp. But the ramp may have safety concerns as it could become slippery or a trip hazard. So the ramp idea is out.
3. Lower side wall height to 6" and 4x10 would have greater volume to our current bin to allow the water to evaporate. I have two labs back to back and the current wood box is a bit small considering the volume of water to clean the equipment.
4. The fork lift is a good idea. Consider having the back side wall hinged, so it could be unlatched to allow the plastic liner with the concrete to slide with ease. You will have to supply chains to attach to the forklift to keep it from sliding off. Remember any mechanical hinging and latching will require thought on how to solve the fact that concrete tools have a tendency to build up residue and cause issues with function over time.
5. Think about a method of attaching the plastic liner so it does not fall down.

Hope this helps you out. See attached drawing.

---

-----Original Message-----

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Sent: Friday, April 27, 2012 12:19 AM

To: Stuart W. Styles; Andrew Joseph Holtz; Greg Lampman; Benjamin Grant Swan; Shaun F. Kelly

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square tubing is aesthetic as well as helping maintain the strength of the bin as it will receive much abuse around the edges. As shown in the pictures, there is a mesh grate on one side. This mesh grate will serve as a spot to place hand tools and other equipment that needs to be rinsed off. The mesh grate is removable via hooks. On the other side (parallel to the mesh grate) you see a half-hopper looking insert. This is a location that the concrete mixers can be rinsed at. The dimensions of the mixers were measured and made sure the slot protruded out enough to completely fit under the mixer's barrels. The other two sides were designed so easier dumping could be possible. They are 12" high at the centers and allow for easier shoveling access in the bin. There are forklift inserts on the bottom as shown.

I wanted to see what kind of feedback you guys had on any part of the design. The design can still be modified. I wanted to estimate the exact amount of steel, because it effects the size sheet that is purchased, thus altering the fabrication process. The goal is to order parts next week so we can put it together before the quarter ends.

Best regards,

-Omar

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77K [View](#) [Download](#)



**Benjamin Grant Swan** [bswan@calpoly.edu](mailto:bswan@calpoly.edu)

Apr  
27

to Omar

Omar: That will satisfy the needs of the classes I teach. Thanks for your diligent efforts! Ben

----- Original Message -----

From: "Omar Adina" <[oadina@calpoly.edu](mailto:oadina@calpoly.edu)>  
To: "Stuart W. Styles" <[sstyles@calpoly.edu](mailto:sstyles@calpoly.edu)>, "Andrew Joseph Holtz" <[ajholtz@calpoly.edu](mailto:ajholtz@calpoly.edu)>, "Greg Lampman" <[glampman@calpoly.edu](mailto:glampman@calpoly.edu)>, "Benjamin Grant Swan" <[bswan@calpoly.edu](mailto:bswan@calpoly.edu)>, "Shaun F. Kelly" <[skelly@calpoly.edu](mailto:skelly@calpoly.edu)>  
Cc: "Bryce A. Dafonte" <[bdafonte@calpoly.edu](mailto:bdafonte@calpoly.edu)>  
Sent: Friday, April 27, 2012 12:19:08 AM  
Subject: Concrete Washout Bin Prototype

Hi All,

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-Omar

--

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**APPENDIX D****CASQA Regulations**



## California Stormwater Quality Association<sup>®</sup>

*Dedicated to the Advancement of Stormwater Quality Management, Science and Regulation*

### California Construction General Permit Overview

On September 2, 2009, the California State Water Resources Control Board (SWRCB) adopted the new state Construction General Permit, Order No. 2009-0009-DWQ the 3<sup>rd</sup> term statewide NPDES General Permit for Construction Activities (CGP, or permit). The new CGP replaces Order No. 99-08-DWQ, with an effective date of July 1, 2010. The permit incorporates several concepts new to construction stormwater permits, which were designed to provide increased water quality protection. The CGP can be downloaded at [http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/constpermits.shtml](http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml).

#### Permit Applicability and Application

All traditional and linear underground/overhead (LUP) construction projects that disturb one acre or more<sup>1</sup> must apply for CGP coverage. Permit Registration Documents (PRD) must be electronically filed for all new projects using the Stormwater Multiple Applications and Report Tracking System (SMARTS), and must include: Notice of Intent, Risk Assessment, Site Map, and Stormwater Pollution Prevention Plan (SWPPP). PRDs will be publically available through SMARTS.

#### Risk-Based Permit

The CGP follows a risk-based permitting approach. Each project is evaluated for *sediment discharge risk* and *receiving water risk*. These factors combine to determine the project Risk Level or LUP segment Risk Type (1, 2, or 3), according to the tables at the right. LUPs can be multiple segments with different Risk Types. Permit requirements progressively increase with risk level/type as summarized below. Some Short-duration projects less than 5 acres, constructed during dry months may qualify for the Rainfall Erosivity Waiver.

Traditional Project Combined Risk Level Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Level 1	Level 2	
	High	Level 2		Level 3
LUP Combined Risk Type Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Type 1	Type 1	Type 2
	Med	Type 1	Type 2	Type 3
	High	Type 2	Type 3	Type 3

Permit Requirement	Risk Level/Type		
	1	2	3
Minimum BMPs <sup>2</sup>	✓	✓+	✓++
Numeric Action Levels (NAL)			
o NAL for pH: 6.5-8.5 pH units		✓	✓
o NAL for turbidity: 250 NTU			✓
Numeric Effluent Limitations (NEL)			
o NEL for pH: 6-9 pH units			✓
o NEL for turbidity: 500 NTU			✓
Visual Monitoring (weekly; before, during, after rain events; non-stormwater)	✓	✓	✓
Runoff Monitoring		✓	✓
Receiving Water Monitoring <sup>3</sup>			✓

Risk Level/Type 2 and 3 sites must test site runoff for turbidity and pH; most testing will be done in the field. Results are compared to the NALs and NELs. An NAL exceedance triggers an evaluation of the BMPs and corrective action. An NEL exceedance is a violation of the CGP, which can result in enforcement action by the Regional Boards, including Mandatory Minimum Penalties (MMP). MMPs carry a fine of \$3,000. Other types of enforcement actions can result in higher penalties.

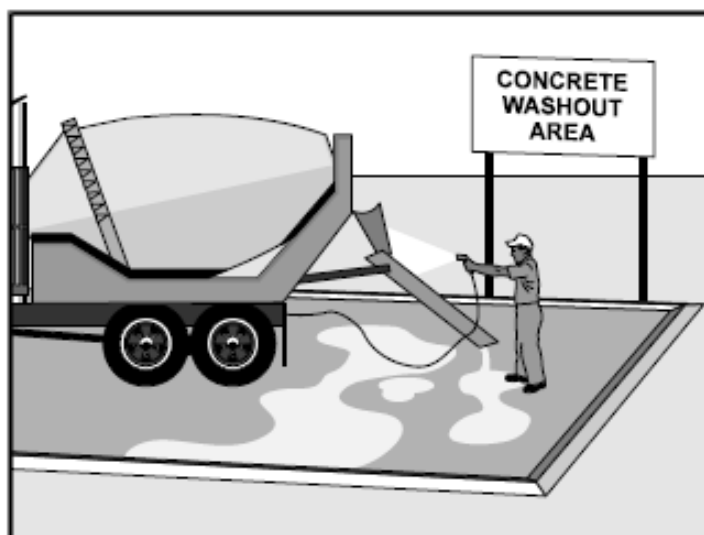
<sup>1</sup> Under some conditions, smaller projects must apply for CGP coverage. See section B of the CGP.

<sup>2</sup> Minimum BMPs progressively increase with project Risk Level or Type.

<sup>3</sup> Receiving water monitoring may be required for some Risk Level/Type 3 projects. See Attachment E of the CGP.

# Concrete Waste Management

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### Description and Purpose

Prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area, and by employee and subcontractor training.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials, including mortar, concrete, stucco, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows and raising pH to levels outside the accepted range.

### Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing portland cement concrete (PCC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.

### Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	<input checked="" type="checkbox"/>
WM	Waste Management and Materials Pollution Control	<input checked="" type="checkbox"/>

### Legend:

- ☒ Primary Category  
☒ Secondary Category

### Targeted Constituents

Sediment	<input checked="" type="checkbox"/>
Nutrients	
Trash	
Metals	<input checked="" type="checkbox"/>
Bacteria	
Oil and Grease	
Organics	

### Potential Alternatives

None



## Concrete Waste Management

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- Concrete trucks and other concrete-coated equipment are washed onsite.
- Mortar-mixing stations exist.
- Stucco mixing and spraying .
- See also NS-8, Vehicle and Equipment Cleaning.

### Limitations

- Offsite washout of concrete wastes may not always be possible.
- Multiple washouts may be needed to assure adequate capacity and to allow for evaporation.

### Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas. Refer to WM-1, Material Delivery and Storage for more information.
- Avoid mixing excess amounts of concrete.
- Perform washout of concrete trucks in designated areas only, where washout will not reach stormwater.
- Do not wash out concrete trucks into storm drains, open ditches, streets, streams or onto the ground. Trucks should always be washed out into designated facilities.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - On larger sites, it is recommended to locate washout areas at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Washout wastes into the temporary washout where the concrete can set, be broken up, and then disposed properly.
  - Washout should be lined so there is no discharge into the underlying soil.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- See typical concrete washout installation details at the end of this fact sheet.

### Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.



## Concrete Waste Management

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- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.
- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.

### *Concrete Demolition Wastes*

- Stockpile concrete demolition waste in accordance with BMP WM-3, Stockpile Management.
- Dispose of or recycle hardened concrete waste in accordance with applicable federal, state or local regulations.

### *Concrete Slurry Wastes*

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below).
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut concrete slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine or by sweeping. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Concrete slurry residue should be disposed in a temporary washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

### *Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures*

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

## Concrete Waste Management **WM-8**

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- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Temporary washout facilities should be lined to prevent discharge to the underlying ground or surrounding area.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of or recycled offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of or recycle hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft; however, smaller sites or jobs may only need a smaller washout facility. With any washout, always maintain a sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
  - Materials used to construct the washout area should conform to the provisions detailed in their respective BMPs (e.g., SE-8 Sandbag Barrier).
  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
  - Alternatively, portable removable containers can be used as above grade concrete washouts. Also called a "roll-off"; this concrete washout facility should be properly sealed to prevent leakage, and should be removed from the site and replaced when the container reaches 75% capacity.
- Temporary Concrete Washout Facility (Type Below Grade)
  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.
  - Lath and flagging should be commercial type.
  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.



## Concrete Waste Management

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- The base of a washout facility should be free of rock or debris that may damage a plastic liner.

### ***Removal of Temporary Concrete Washout Facilities***

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and properly disposed or recycled in accordance with federal, state or local regulations. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and properly disposed or recycled in accordance with federal, state or local regulations..
- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

### **Costs**

All of the above are low cost measures. Roll-off concrete washout facilities can be more costly than other measures due to removal and replacement; however, provide a cleaner alternative to traditional washouts. The type of washout facility, size, and availability of materials will determine the cost of the washout.

### **Inspection and Maintenance**

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and properly disposed or recycled in accordance with federal, state or local regulations.
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.
- Inspect washout facilities for damage (e.g. torn liner, evidence of leaks, signage, etc.). Repair all identified damage.

### **References**

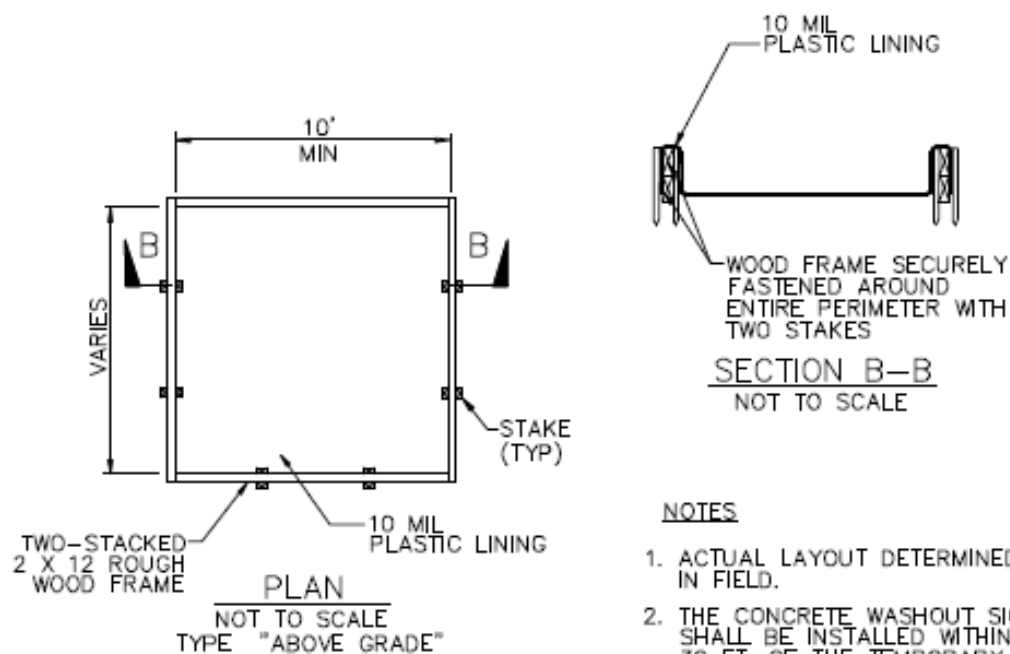
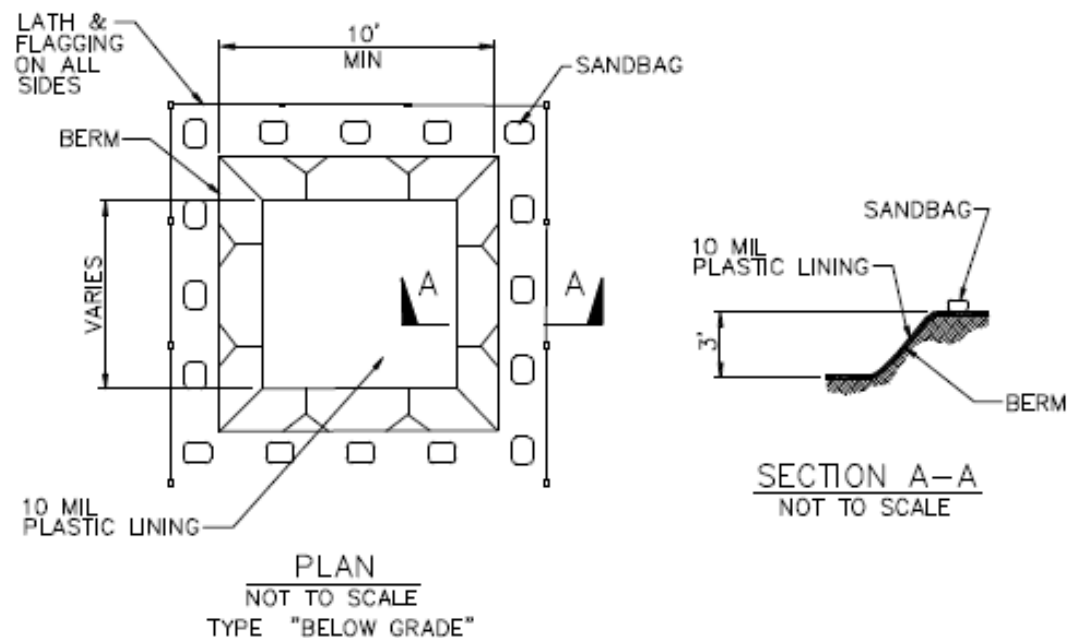
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000, Updated March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Concrete Waste Management

# WM-8



## NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

# Concrete Waste Management

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